
IMAGINE the next century...
UNMANNED AERIAL VEHICLES
NANOTECHNOLOGY
ADVANCED ENERGETICS
HYPERSONICS
DIRECTED ENERGY

# WELCOME

....to the future! For most of us, day-to-day life doesn't leave time for the luxury of imagining and dreaming about the future. But for the men and women of the Air Force's Directorate of Strategic Planning (AF/XPX), it's our fulltime job. For us "the future is now." These inevitable technological developments create both opportunities and challenges. The opportunities offered by new propulsion methods will enable speeds of MACH 5, 6, 7 and beyond. Nanotechnology will accomplish the ultimate "micro-downsizing" of virtually all future components. Unmanned air and spacecrafts will be capable of feats beyond our imagination. On the other hand, the challenge of integrating and developing these new capabilities into logical strategic and tactical concepts of operations and the human skills required to operate them is a daunting task. In the future, we won't be the only ones with access to these technologies. Our constant challenge is staying well ahead of our adversaries.

This magazine is designed to give you a glimpse of a possible future world and some of the transformational initiatives already underway. **It presents four broad topics within which we frame our view of the future world.**

### PERSISTENT *C4ISR

Harnessing the integration of manned, unmanned and space-based sensors and monitoring technology to provide persistent situational awareness and decision-quality data for rapid decision-making ability.

### GLOBAL MOBILITY

Providing the rapid, timely, and effective projection, employment, and sustainment of U.S. power through air mobility, global command and control, expeditionary air bases, and space mobility.

### RAPID STRIKE

Planning, organizing, and equipping to provide a broad range of capabilities enabling a series of effects appropriate to neutralizing any type of potential global threat.

### TRANSFORMING THE FORCE

Recruiting, training, educating, organizing and retaining the highly skilled and educated Airmen of the future and supporting them with the best operational doctrine and concepts possible.

We welcome you to our view of the future and believe that you will have the same reaction that we do every day — "WOW"!

* C4ISR is Command Control Communications Computer Intelligence Surveillance Reconnaissance.

# FOREWORD

In late 2003 we celebrated a century of flight and marveled in retrospect at the courage, vision and ingenuity of our nation's aviation pioneers. We were also awed by the incredible progression of innovation and invention achieved during that time. Such reflection naturally invites one to look ahead into the future -- to **imagine** the next century.

Throughout our distinguished history, America's Air Force has remained the world's premier air and space power because of our professional Airmen, our investment in technology, and our ability to integrate our people and systems to produce decisive results. These Air Force competencies, along with today's pioneering visions and imagination, will ensure that we are prepared for the unknown threats of an uncertain future as well as the opportunities that decades ahead will provide.

In the geopolitical environment of the 21st century, we will continue to fulfill our obligation to protect America, deter aggression, assure our allies, and defeat our enemies. As we adapt the Air Force to the demands of this era, we are excited by what we can already see within the realm of the possible – hypersonic vehicles, use of nanotechnology in micro-UAVs, micro-satellites and micro-sensors, directed energy, unprecedented levels of precision and persistence, and technologies beyond our imagination. While the past century was predominantly one of manned flight, we envision the next century to be increasingly one of unmanned flight. Our talented Airmen will still be at the controls, but with the increasing benefits of stealth, reach-back and network-centric operations, they will be at decreasing risk!

We invite you to join us in the opportunity to **IMAGINE** the Next Century...

INFORMATION OPERATIONS

# Seeing and Hearing is

Information is perhaps the most crucial resource for any military fighting force. The surge of technological advancements in the Information Age has changed how we collect and use information to coordinate effective and precise operations. Information Operations **(IO)**, used both offensively and defensively, will continue to be an integral component of future military strategies, leading us to more successful operations with reduced risk. Incorporating electronic warfare, network operations and influence operations, IO enhances the advantages over our adversaries.

**Imagine** the scenario: a terrorist's Personal Digital Assistant (PDA) with voice and high rate data is useless thanks to a jamming signal sent from an Unmanned Aerial Vehicle **(UAV)**, loitering unseen, miles away. Or another scenario: revolutionaries attempt to plan an attack using secure websites and encrypted emails, only to find that their electronic devices have been "fried" by electronic attack. These examples of **Electronic Warfare Operations** occur today and will only get more sophisticated tomorrow as our technology and training progress.

If information is key, then our system for securing and housing that information is vital to our success. Protecting our network operations security centers is of the utmost concern. **Network Operations** gives us the ability to defend our national security, as well

PSYOP

# Winning Over Hearts and Minds

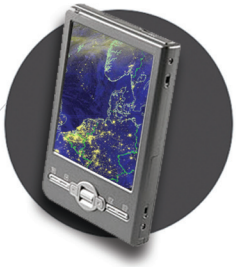
Generally, the term "**PSYOP**" conjures up images of leaflets falling from the sky sending America's message of relief, strength, and compassion. Leaflets will still be used in future **Psychological Operations.** Technological improvement will allow us to send our message out with greater precision, in innovative ways.

**Imagine** the psychological impact of the following scenarios:

- Target regions are alerted 24 hours prior to an offensive mission through satellite, near space, and UAV PSYOP broadcasts.

# BELIEVING

as attack adversaries in the modern threat environment. The possibility of cyberterrorism threats will increase into the future as hacking tools continue to be more available and adversaries become more technologically savvy. Training exercises that test real-life scenarios, allow the Air Force to test its IO performance and identify potential weaknesses and opportunities for improvement.



Moving from the more technical side of Information Operations, **influence operations** directly address how we share our message. What we say and how we deliver our message can drastically affect outside support, potential resistance, and progress in rebuilding efforts following a conflict. Influence operations through satellite, TV, radio, faxes, email, instant messaging, and even cellular phone calls, carry America's message to civilians, military, and leaders alike.

Information Operations is defined as the integrated employment of three operational elements – electronic warfare operations, network operations and influence operations – to affect or defend decision makers and their decision-making process.

IO affords us the ability to achieve operational success through our strategic use of information. As threats to our national security continue to become more advanced, so must we. IO is the key to keeping our edge in the next century. □

- People in population centers with few media options watch a presidential address beamed out to their cable network, reaching mass populations otherwise devoid of access
- Thanks to our broadcast capabilities, adversary leadership and other selected targets read messages delivered directly to their PDA's, cellular phones, and other personal communications devices,

Near-space platforms and UAV technology may open greater opportunities for PSYOP missions due to their stealth and communication capacities, as well as the ability to carry payload for leaflet distribution. Winning hearts and minds requires expert strategy and superior technology to enable overall IO operations. □

NETWORK-CENTRIC OPERATIONS

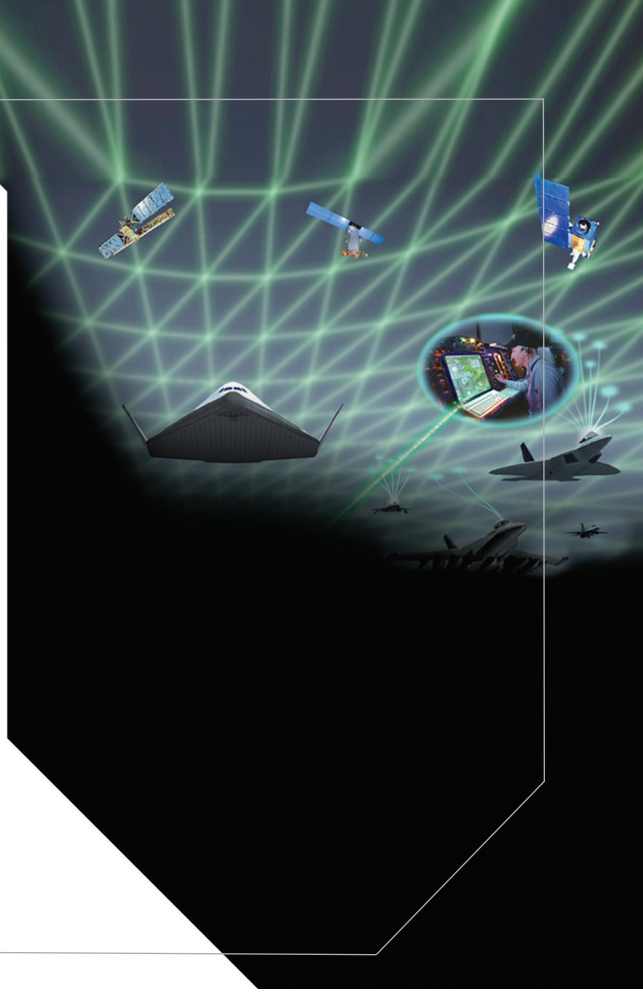
# Lifting the Fog — Living in

Warfare has played a pivotal role in the drama of human experience. Yet Warfighters throughout history have frequently engaged in combat with a poor understanding of their combat situation. During the past 50-60 years, our military made great strides in enhancing the gathering, dissemination and management of information. Nevertheless, too often those most in need of information and understanding about their circumstances on the battlefield lacked the knowledge required to fully achieve their goals. This classic state of confusion in combat is captured in the old metaphor, "the fog of war."

Now **imagine** a fully integrated, secure network infrastructure, one that supplies data efficiently across land, sea, air, and yes, space, "fusing" thousands of data sources. What if the data could pass machine-to-machine, building a dynamic, real-time image of the battlespace that vastly enhances our Warfighters' understanding of their combat situation? Click on an icon to reveal the important data about each aircraft -- its location, time overhead, fuel state, weapons available, damage status -- anything you need to know about that aircraft and its relation to the battle. Now, name the target and let the system instantly send the most appropriate weapon to accomplish the mission.

## Key Tenets of Network-Centric Warfare

- A networked force improves information sharing.
- Information sharing enhances shared situational awareness.
- Shared situational awareness enhances speed of command.
- Speed of command results in dramatically increased mission effectiveness.



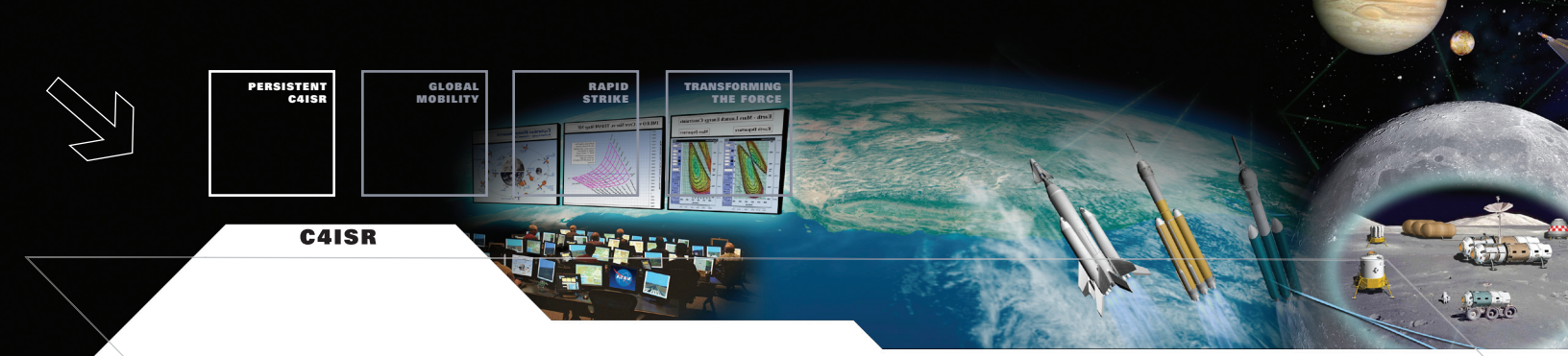
# "The Grid"

That's just one example of the speed and effectiveness that will occur as a result of network-centric warfare. It's a system that links aircraft, ships, tanks, weapons, sensors and satellites to each other and the Air and Space Operations Center (ASOC) using horizontal integration of modular components and "language" all systems and end-users will understand, thus creating **Shared Situational Awareness**. Benefits already being realized via this "Global Information Grid" include **Blue Force Tracking**, electronically "marking" of all friendly forces in the battlespace, and **Link 16** Fighter Data Link **(FTD)** terminals, a secure, jam-resistant system used to share tactically useful information among fighters, sensors and command and control platforms.

**Imagine** "swarming" UAVs and a broad range of sensors, including airborne and space based systems, tied into this network and you can easily imagine the **Persistent Area Dominance** that this technology will enable. Whether in business or national security, information loses its value when it's not converted into knowledge and distributed to decision-makers. Within the Air Force we strive to attain **Information Superiority** over our enemy in order to achieve **Decision Dominance**, providing us the ability to accomplish our objective whether that objective is to take out an enemy communications center or to deliver tons of food and medicine in a humanitarian relief effort. Linking together our data, people and capabilities will ensure we can always put "the cursor over the target" anytime, anywhere. □

*"You've got to really reorganize your organization and your processes to take advantage of the information being everywhere instantaneously."*

– Maj Gen Charles E. Croom Jr.
Director, C4ISR Infrastructure,
DCS for Warfighting
Integration, HQ USAF

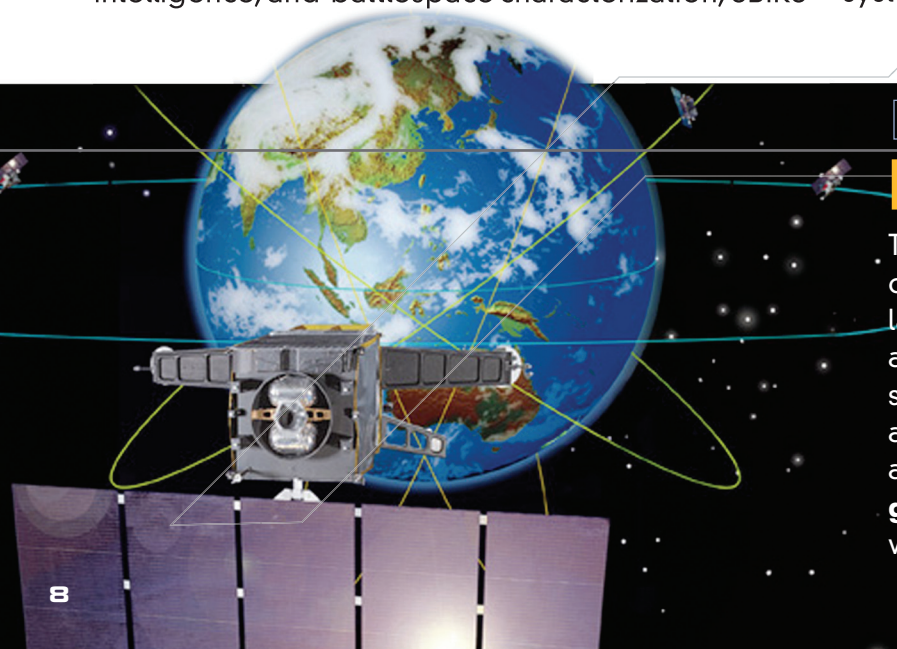



# Decision Dominance

"C4ISR" is a complex idea involving **C**ommand, **C**ontrol, **C**ommunications, **C**omputers, **I**ntelligence, **S**urveillance and **R**econnaissance systems and the highly trained people who employ the multitude of systems. However, what we're really talking about is the collection, analysis, assurance, management, integration, fusion and dissemination of information. Where our capabilities to acquire and use information outstrip those of the adversary, while simultaneously denying them the capability to make effective use of their own information resources, we achieve **Information Superiority**. However, this is not enough. The ultimate objective is to give commanders a capability to make high-quality and timely decisions that result in desired effects on the enemy – faster than the adversary can react to adapt, defend, or strike back. This is **Decision Dominance**.

There are hundreds of component sub-systems ultimately feeding the entire C4ISR capability that enables Decision Dominance. One system starting to move from the drawing board towards near future deployment is the Space-Based Infrared System **(SBIRS)**. Designed to significantly enhance capabilities for missile defense, technical-intelligence, and battlespace characterization, SBIRS will also ultimately replace legacy Defense Support Program (DSP) missile warning satellites. This system will be composed of 5 satellites in geosynchronous orbits, 2 satellites in highly elliptical orbits, and supporting ground processing stations. These assets may be complemented later by a series of low earth orbit satellites. These space-based assets will utilize state-of-the-art short-wave, mid-wave and "see-to-the-ground" infrared bands enabling a much broader set of missions within their missile warning, missile defense, technical intelligence and battlespace characterization portfolio.

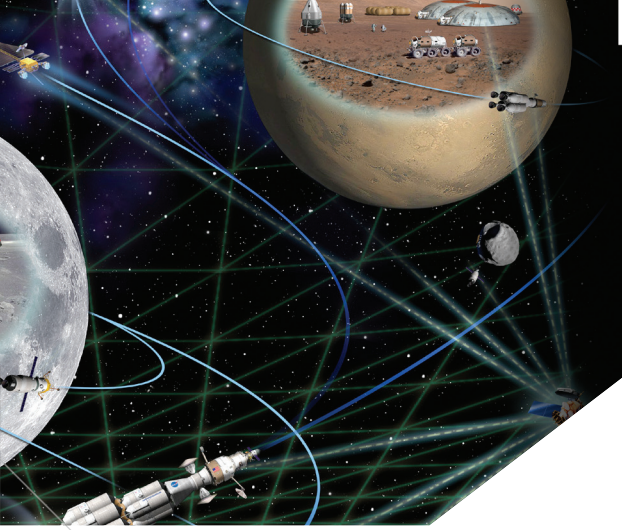
Fused with other ISR Systems, Surface Moving Target Indicator **(SMTI)** Radar will provide joint force commanders with unprecedented awareness of the battlefield. Employing highly sophisticated Doppler radar technology, triangulation, high-tech imagery and other ISR techniques, this technology provides the ability to tag and track hostile ground vehicles on a dynamic yet congested battlefield. **Imagine** piloting an F/A-22 at 50,000 ft. and 50-miles from the target, scoring a direct hit on a tank moving through a congested traffic that includes non-combatants. By integrating future generations of this technology into near space, satellite-based and manned C4ISR systems we will continue to make progress towards



SATELLITE COMMUNICATIONS

## Direct Connect

The satellites that will support our Warfighter's C4ISR capabilities in the next century ahead will employ laser optics, enabling high-speed communication and sharing of information with us at a rapid rate of speed. Once the constellation of Transformational Communication Satellites **(TSAT)** are launched and orbital, a new level of communication and **global situational awareness** for the future force will be realized.



providing our War-fighters with the capabilities they need to know more, understand better, and act faster than their adversaries. ☐

## TRACKING FROM SPACE

- The Space Radar **(SR)** will operationalize SMTI which, from space, can track slow-moving objects as small as a car. The system will provide 24/7, all weather detection and tracking of moving targets.
- Critical data will be down linked in real time to the Warfighter for support of ongoing combat operations.
- The SR-Type systems will give military commanders the ability to simultaneously look deep into denied areas of interest, in multiple regions around the world, across all levels of conflict on a non-intrusive basis without risk to personnel or resources.

# Communication

TSATs will provide an unprecedented level of connectivity giving them the ability to receive and send information at extremely high speeds across great distances. For example, a TSAT could receive vast amounts of information transmitted by a reconnaissance aircraft then turn around and send the information to forces on the ground, all within seconds. The advanced laser optics that will connect TSATs will help to create an integrated network, enabling direct machine-to-machine links and reduce delays associated with systems that are not directly connected and integrated.

Think of the TSAT network like the Web with high-speed communication between networks and multiple users able to instantly access information as soon as information is "live". ☐

# The Ultimate High Ground

Today space power provides enabling functions such as communications, Intelligence Surveillance Reconnaissance **(ISR)**, warning, weather, and global positioning through application of the latest technologies in those areas. Nevertheless, the Air Force is well on its way to combining the satellite capabilities that yield space superiority to our land, sea and air superiority to achieve Full Spectrum Dominance.

Let's look at the current "art of the possible." **Milstar**, the first satellite system to allow all services to communicate with one another on the same secure network has been critical in many operations, including the precise transmission of targeting information for Tomahawk cruise missiles.

The Defense Meteorological Satellite Program fleet provides critical data enabling nighttime parachute drops with pinpoint forecasts and ground operations throughout adverse weather conditions. Our satellite-based ISR capabilities are proving increasingly valuable in identifying and tracking a dispersed enemy in the global war on terrorism. Additionally, Air Force Space Command **(AFSPC)** is providing the highest global positioning accuracy possible via GPS, bringing an unprecedented level of situational awareness to the battlespace.

**Imagine** advances in all of the above areas. New systems such as the Advanced Extremely High Frequency **(AEHF)** system, Transformational Communication Satellites **(TSAT)**, GPS III, and "Wideband Gapfiller" satellites will attain new levels of command, control, and communications (C3) capability and security. Space Radar **(SR)** will provide persistent global situational awareness and target tracking capability, day or night, all weather, globally. New tactical micro-satellites will be deployed to create a **Joint Warfighting Space** concept, providing operational and tactical capabilities to the theater commander. We can rest assured that the Air Force is committed to maintaining our advantage in space and training space professionals dedicated to and focused on this newest common environment! ☐

EELV

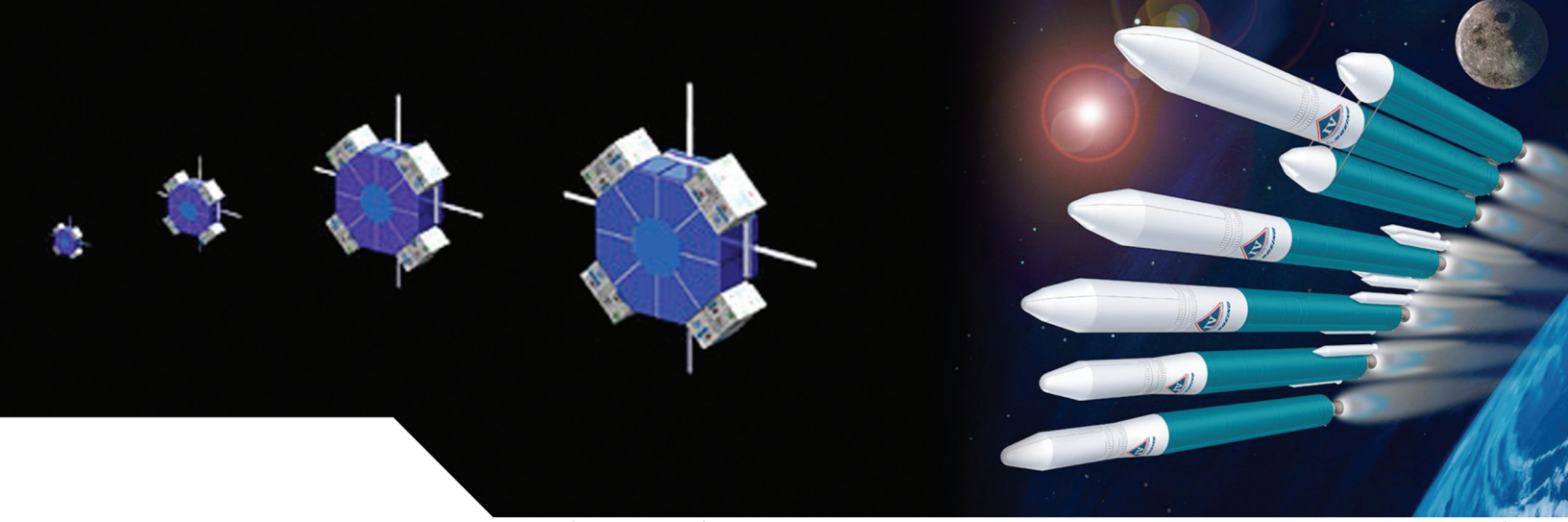
## EVOLVED EXPENDABLE LAUNCH VEHICLES (EELVs)

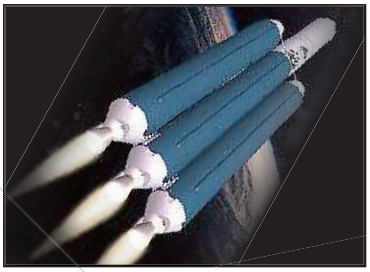
**Currently, the Air Force utilizes two operationally responsive EELVs:**

**Atlas V**
A 192 feet high rocket with a standard booster that makes up about one third of its length and, depending on the load, can be configured to accommodate payloads up to 19,000 pounds.

**Delta IV**
A blend of new and mature technologies needed to launch virtually any size payload into space. The Delta IV has various configurations capable of payloads up to 27,000 lbs.

**Future EELVs will need to provide reduced launch cycle times, from weeks and months to hours and days!**





**NEAR-SPACE...**the area above the Earth's surface above where air-breathing flight can occur (65,000 ft.) and below where true orbital space begins (around 325,000 ft.).

Previously not considered applicable for military use, a confluence of technological advancements in power supplies, miniaturization and lightweight, strong, flexible materials is making near space capabilities possible. This is causing a re-evaluation of some orbital space concepts for a variety of systems. Near-space deployment of certain capabilities such as communications or ISR, may prove more practical, and possibly more effective and affordable than orbital space methods. **Imagine** one of the concepts being explored: the use of high-tech lighter-than-air, maneuverable balloons.

## Air Force Stands Up UAV Center of Excellence

Unmanned Aerial Vehicles (UAVs) are remotely piloted or self-piloted aircraft that can carry cameras, sensors, communications equipment or other payloads. They have been used in a reconnaissance and intelligence-gathering role since the 1950s, and more challenging roles are envisioned, including combat missions. Unmanned Aerial Vehicles have been vital in Operation Enduring Freedom and Iraqi Freedom.

The Air Force recently announced that they intend to stand up an Air Force Unmanned Aerial Vehicle Center of Excellence in Indian Springs Auxiliary Field in Nellis Air Force Base in Nevada. The center will coordinate UAV activities at the tactical, operational, and strategic levels, working to provide a common structure for UAV command and control systems. It will improve the interoperability among the various systems and develop the common operating systems, standards, requirements, concepts of operations, and training necessary to provide joint warfighters the information they need.

Air Force leaders have recognized the incredible value of UAVs in the global war on terror. With one center, they will be able to capitalize on the currently capabilities that UAVs possess, and also look to what the future requirements will be.

Indian Springs was chosen as the spot for the center for numerous reasons. First, Predators already operate from there, it has an experienced cadre and the infrastructure to handle the new center. The Nellis Test and Training Range is the perfect venue to continue exploring the capabilities of UAVs. In addition, Indian Springs is located near the National Training Center that will allow the Air Force to work jointly with the other services. Many important events already take place at Indian Springs including the various Flag exercises, the Air Warrior Connection for the National Training Center, the Naval Strike Warfare training, and Army and Marine Corps training.

Through the creation of the center, the Air Force hopes to develop future UAVs that can be persistent, survivable and can loiter over the battlefield for long periods of time.

AIRLIFT

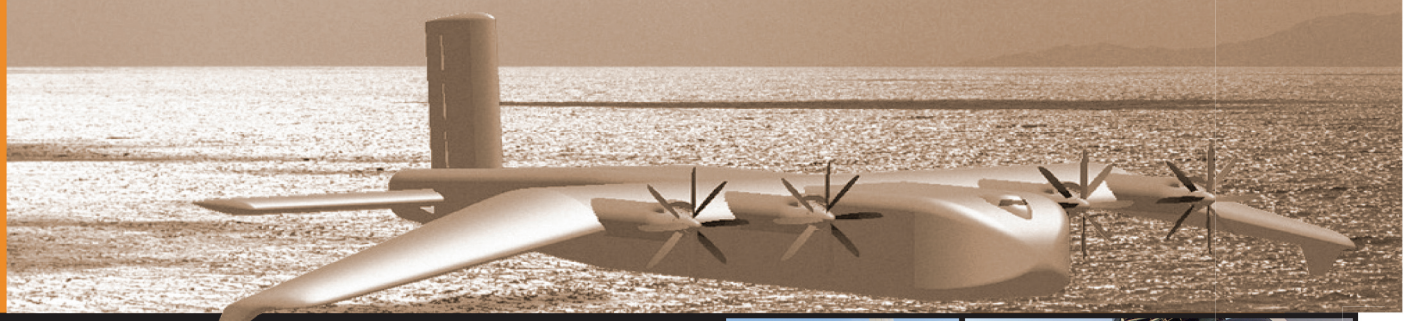
# AIRLIFT TO ULTRA LIFT

## Combat Ready Combat Proven

Given the expeditionary nature of the military, little could happen globally without the rapid, flexible and responsive air mobility provided by the 150,000 person Total Force of AMC and their impressive inventory. While the high operations tempo of the Global War on Terrorism occupies most members of the team with more than 40,000 flight hours per month, staff at the Air Mobility Battlelab, the Defense Advanced Research Projects Agency (DARPA), other agencies and private industry, are contemplating the future of airlift. Rapid technological advances are bringing radical new concepts into the "realm of the possible." Some representing theoretical breakthroughs and others putting a new spin on some future of logistics.

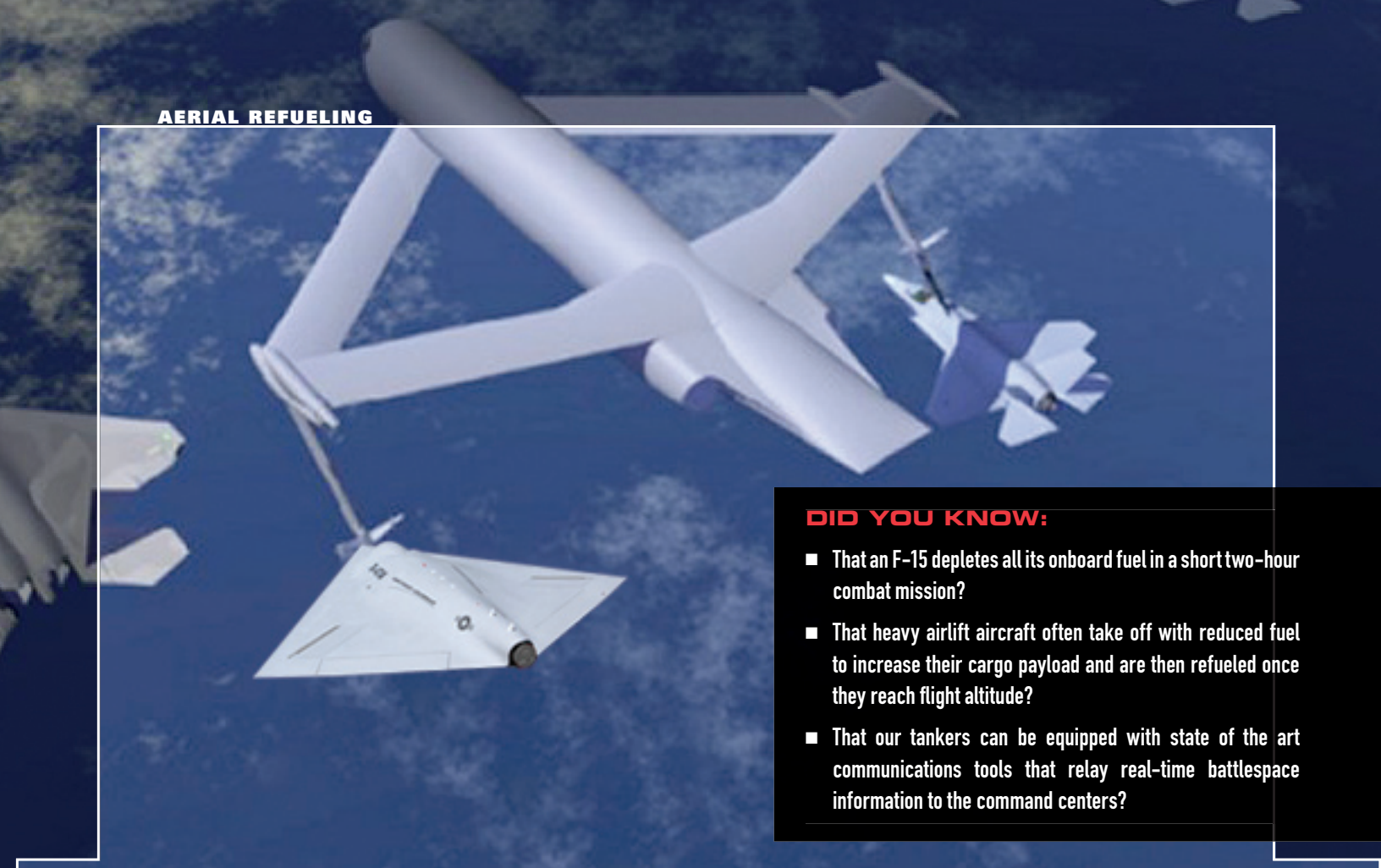
One of the radical new concepts has been code-named the Pelican Ultra (Ultra Transport Aircraft). A high-capacity, long-range, transoceanic transport, the Pelican Ultra would fly as low as 20 feet above the sea, exploiting the aerodynamic benefits of a phenomenon called ground effect. The result is a major reduction in drag and outstanding cruise efficiency. The Pelican Ultra would have a 500 ft. wingspan, be capable of carrying up to 1,400 tons of cargo (think 17 M-1 tanks) and a cruising distance of some 10,000 nautical miles over water. Another concept being investigated, called the **Blended Wing Body**, resembles a flying wing. A unique merger of efficient high-lift wings and wide air-foil-shaped body significantly increases lift while minimizing drag.

Now **imagine** an Ultra-Large Airship **(ULA)** the size of an aircraft carrier, combining lighter-than-air concepts, new high-strength "skins" developed with nanotechnology and employing radical new aerodynamic designs and propulsion systems, capable of airlifting an entire army brigade into a theater of action. The ultimate combination of old and new technology designed to support the mobility requirements of new operating concepts such as the Army's Stryker Brigade and Future Combat Systems. □



### THE ARMY'S STRYKER BRIGADE

A fast and lethal deployable brigade (3,500 personnel) capable of rapid movement worldwide. Named for the medium weight armored vehicle it employs. Combined with Air Force mobility assets, this Army fighting force can deploy within 96 hours of notification.



**DID YOU KNOW:**

- That an F-15 depletes all its onboard fuel in a short two-hour combat mission?
- That heavy airlift aircraft often take off with reduced fuel to increase their cargo payload and are then refueled once they reach flight altitude?
- That our tankers can be equipped with state of the art communications tools that relay real-time battlespace information to the command centers?

# ANY TIME, ANYWHERE

Our aircraft are traveling farther than ever to secure and protect America and its Allies. Aircrews can't always count on having a convenient and safe place to refuel. Plus refueling stops slow down the mission. What do you do? Have the fuel come to you!

The two primary air refueling tankers that the Air Force utilizes to provide fuel to Air Force, Army, Navy, Marine and Allied Forces aircraft are the KC-135 Stratotanker and the KC-10 Extender.

Not only can each of these aircraft carry over 200,000 (29,850 gallons) pounds of fuel, each is capable of delivering thousands of pounds of cargo. These aircraft are even able to refuel 2 aircraft simultaneously when equipped with **Wing Air Refueling Pods**(KC-10) or **Multi Point Refueling System Pods**(KC-135).

During wartime, these tankers remain airborne in their assigned theater almost indefinitely, waiting to refuel. When they have completed their mission they can fly back to base for quick-turn refueling, and start over. Tankers are often deployed when heavy airlift aircraft, such as a C-5 Galaxy, are flown. When heavy airlift aircraft are fully loaded they can be so heavy that they need to take off with a reduced fuel load and then "top-off" once they reach a stable flying altitude.

Today, we are maximizing the use of our KC-135s by adding communications platforms called **Roll-on Beyond Line of Sight Enhancement (ROBE).** ROBE translates and extends the range of radio communications, allowing all Warfighters to have the same situational awareness, whether en route, engaged or refueling.

**"Smart" tankers** that are currently under development will be important nodes in the communication network, as well as having the ability to refuel up to three aircraft simultaneously – including UAVs. As directed energy weapons become more common, aerial refueling becomes that much more important – more fuel equals more laser shots! ☐

HUMANITARIAN RELIEF

# HELPING THOSE IN NEED

When conflicts occur on foreign soil, innocent civilians invariably are caught in the crossfire. Electric power and water are undependable. People are out of work. Children no longer attend school. Businesses are boarded up. Morale is low and basic necessities can be scarce.

As training and technology continue to advance, so too will **Humanitarian Assistance** missions. Faster response times, greater reach to civilians in need, and advanced medical treatments will be the sign of the future.

Delivering food rations, tents, sleeping bags, water purification equipment, medical kits, and even portable kitchens are all part and parcel of what current missions entail. In the future, the deliveries may include such items as communications hardware, biomedical treatments to counter bio-warfare, laser eye protection goggles, all delivered by UAVs.

Airmen will continue to assist damaged areas with structural rebuilding and medical attention to those in need. These men and women become de facto ambassadors of America's compassion and goodwill.

However, not all humanitarian efforts deliver concrete social services. In a conflict scenario, forces progress into the core battlefield area, conducting **Stability Operations**, leaving outer areas in need of security and stability. At best, these forces operate with caution, but encounter little resistance and maybe even gratitude. They become familiar faces in the community, even if for a short time. At worst, they are treated like the enemy and interact violently with isolated factions unwilling to acknowledge defeat. Both Humanitarian and Stability Operations missions provide the tactical and strategic ingredients needed to assist communities in need.

As the modern landscape changes and asymmetric warfare becomes more common, Airmen will face unique challenges, especially in urban settings. In one part of a city, Stability Operations may occur while simultaneously, in another part of the city, Air Force medical personnel may be examining patients. These blended operations demand highly flexible and dedicated Airmen to adjust quickly to the realities of assistance during conflict.

In the future, the humanitarian assistance the Air Force provides may be more high-tech, but will still serve America's ultimate goal: the preservation of life, liberty, and the dignity of all mankind. ☐

DISASTER RELIEF

# SAMARITANS

Fire retardant air drop missions over thousands of acres, saving forests threatened by wild fires. Search and Rescue (SAR) teams fly over heavily flooded areas conducting rescue and recovery missions.

While we can't control the weather...yet, or its adverse effects, we continue to advance our technology and training. These improvements will better prepare us for serving populations overwhelmed by natural disasters.

Fire Suppression and SAR are just two examples of how the Total Force continues to support natural disaster relief efforts, including floods, earthquakes, hurricanes, wildfires, and more. In the future, UAVs may be used to assist search and rescue operations by conducting initial surveillance sweeps to locate downed or lost civilians. Maybe even a CV-22 helicopter will be used for rescue missions, affording SAR teams rapid response and powerful support to troubled areas.

The benefits of disaster relief sorties and missions are two-fold: we help communities in need at home and abroad, while using the experiences to further hone our skills for future military operations. For instance, the C-130 Hercules aircraft used to drop fire retardant on wild fires typically fly at 300 feet or higher during day-to-day operations. But wildfire missions are more demanding. **Imagine** the situation: to accurately drop the fire retardant onto the target area, pilots fly at around 125 feet, close to trees, enveloped in smoke, truly testing their aviation skills for future combat scenarios. ☐

## A Gift from America –

### Humanitarian Daily Ration (HDR)

- First used in 1993 in Operation Provide Promise over Bosnia.
- From 1993 – 2004, over 8 million rations have been provided to refugees in Iraq, Cuba, Bosnia, Rwanda, and Haiti.
- Prepared to be nutritious, ready to eat foods, that are also culturally sensitive.
- Packaged in bright yellow packets for easy identification when they reach the ground.
- Tend to have a shelf life of 18-24 months.

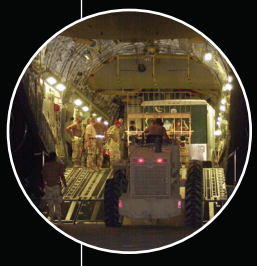
# AIR FORCE BOOTS

## EXPEDITIONARY BASE OPENING

All aircraft, even UAVs, need to land. And when those landings are in a combat zone, and an expeditionary base needs to be established, it's very likely that personnel of the Air Force's Tactical Airlift Control Element, units of the Contingency Response Group or a RED HORSE team will be there to secure their landings, unload their cargo, make emergency repairs, provide medical assistance and get them safely back in the air.

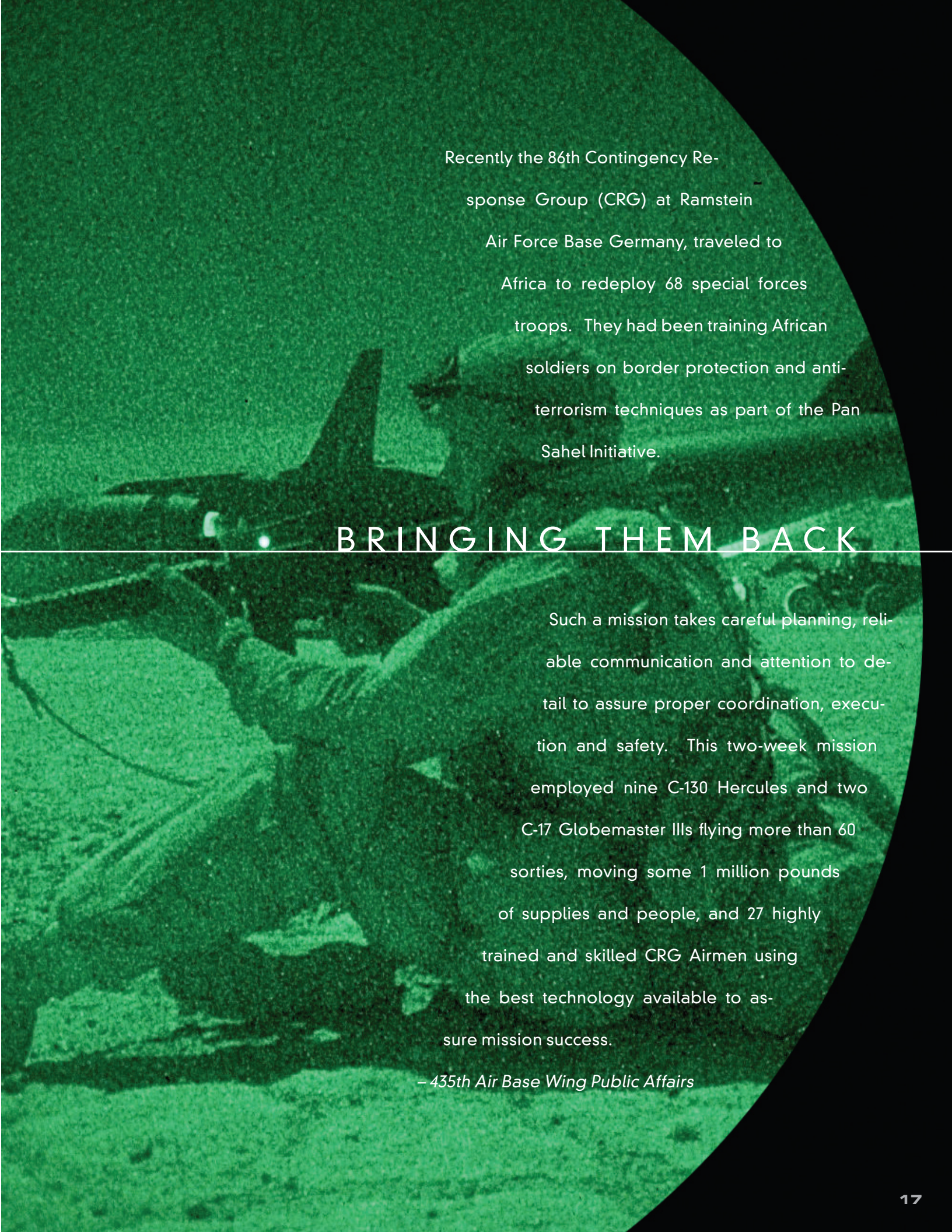
Extending expeditionary air power and dominance around the world is no small undertaking and requires the talents and skills of a great number of personnel in countless professions. There is no better example of this than the RED HORSE Squadrons – Rapid Engineer Deployable Heavy Operational Repair Squadron Engineers. A highly mobile civil engineering response force to support contingency and special operations in remote, high-threat environments worldwide, this 400-person unit, while primarily a civil engineering and construction group, is structured to be completely self-sufficient to perform heavy damage repair required for recovery of critical Air Force facilities and utility systems, and aircraft launch and recovery. They are also a terrific example of joint service cooperation with selected members spending three weeks at the Army Airborne School where they will earn their jump wings.

Another example is the Contingency Response Groups (CRG), small groups designed for



rapid-response deployment specializing in airlift command and control, mobile aerial port operations, force protection, forward area medical operations, humanitarian aid and communications. These teams have a simple, but tough mission: parachute a small group of Airmen into an airfield to set up all facets of air operations – fast. The rest of the team follows and runs the airfield until follow-on forces take over. It was this group that initially secured the Bashur Airfield in Northern Iraq and got the air supply line going.

Offloading a million pounds of cargo a day, working with night vision goggles during blacked-out conditions, and repairing a crumbling runway are all mission critical tasks that the team performs at exceptional levels in difficult environments. A great example of Air Force ingenuity and flexibility in the face of transforming operational requirements, combining old boots with high-tech tools! □

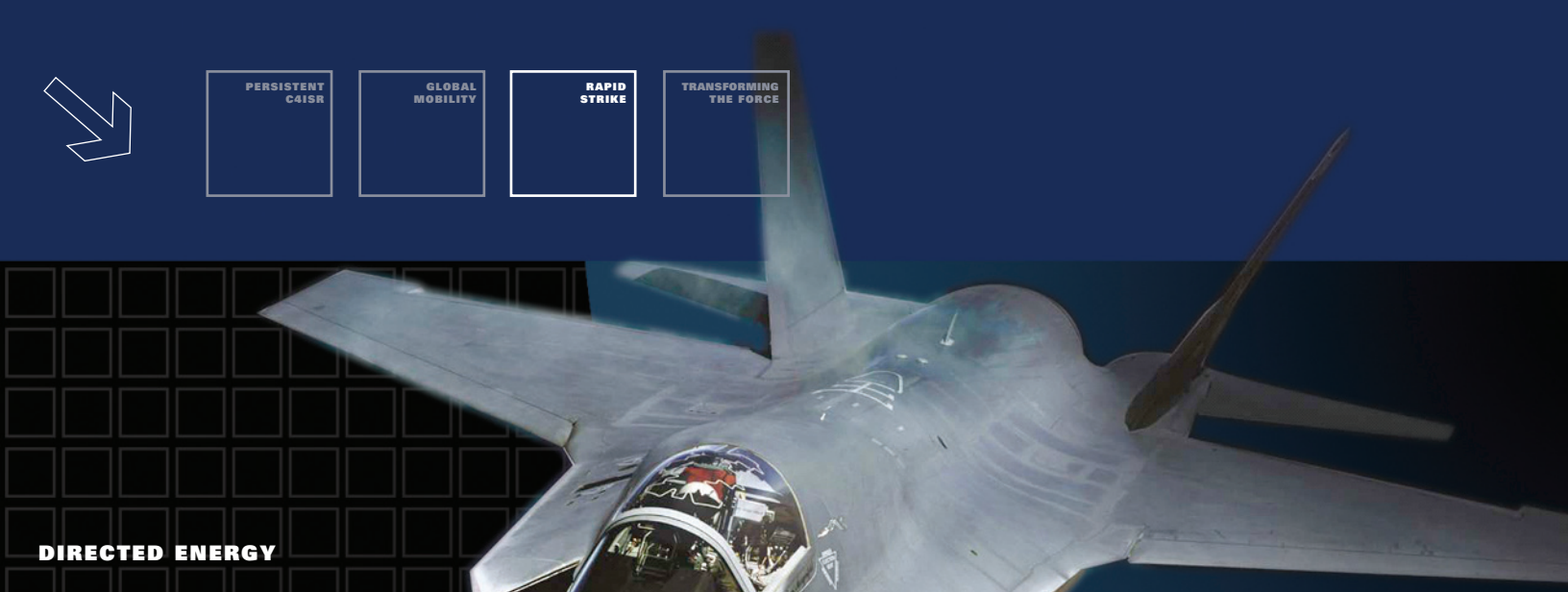


Recently the 86th Contingency Response Group (CRG) at Ramstein Air Force Base Germany, traveled to Africa to redeploy 68 special forces troops. They had been training African soldiers on border protection and anti-terrorism techniques as part of the Pan Sahel Initiative.

## BRINGING THEM BACK

Such a mission takes careful planning, reliable communication and attention to detail to assure proper coordination, execution and safety. This two-week mission employed nine C-130 Hercules and two C-17 Globemaster IIIs flying more than 60 sorties, moving some 1 million pounds of supplies and people, and 27 highly trained and skilled CRG Airmen using the best technology available to assure mission success.

*– 435th Air Base Wing Public Affairs*



DIRECTED ENERGY

# TRADING BULLETS FOR BEAMS

"Directed energy is going to change the way we fight wars in the 21st century much the same as stealth technology did in the late 70s and precision-guided munitions and the (Global Positioning System) did in the 90s."

– Maj Gen Paul Nielsen, AFRL Commander

Devising more powerful, precise, flexible, and even less lethal measures of weaponry is essential to keeping the competitive edge in the global environment of the 21st century. Directed Energy (DE) technology is one way to make that possible.

Images of lasers shot from high-speed aircraft in "Star Wars"-esque fashion are no longer just science fiction. Greater in scope than conventional weaponry, a beam traveling at the speed of light could reach its target in milliseconds and have a range much greater than a bullet or bomb, all with pinpoint accuracy. The research and development of DE capabilities is truly fascinating when considering the possibilities. **Imagine** pinpointing a target on the battlefield and accurately hitting it with a laser located miles away.

What is a DE weapon? It is the use of a beam of concentrated electromagnetic energy or atomic or subatomic particles primarily as a direct means to damage or destroy enemy equipment, facilities, and/or personnel. DE weapons possess unique characteristics such as speed-of-light delivery, deep magazines, long range, accuracy, and precise lethality.

On the horizon, an F-35 Joint Strike Fighter **(JSF)** could be equipped with lasers that have scalable firepower.

Some additional DE projects that are being developed for future military systems are:

- Harnessing **high power microwaves** to damage enemy electronic devices. This short, concentrated energy burst would not harm people but would cause electronic systems to fail, giving our forces an edge at a low-collateral cost.
- The **Active Denial System (ADS)** – a breakthrough, less lethal technology that projects an energy beam to induce a painful burning sensation on an adversary's skin, causing that individual to be repelled without injury. Mounted on a gunship, ADS could be used in a variety of hostile situations where we need to stop a mob without causing any serious injury.
- **Airborne Laser (ABL)**, the world's first laser-armed combat aircraft. This 747-400F uses a system of powerful lasers to target and destroy ballistic missiles shortly after they launch. Working with high altitude airships carrying sophisticated lenses and mirrors, the ABL will be able to strike ballistic missiles from double the range. □

# TRUE PRECISION STRIKE

Only 60 years ago, air-to-ground strikes involved hundreds of aircraft, tons of explosives and incendiaries causing destruction and collateral damage and deaths over a wide area. Today is the era of precision strike. A very small number of stealthy aircraft employing laser and GPS targeting technology, laser-guided bombs and Joint Direct Attack Munitions **(JDAM)** can destroy individual buildings, a single missile launcher or even a single vehicle.

Technology, however, continues to transform, providing even more enhancements impacting the very definition of precision. Our technological advancements and the effects required to fight the Global War on Terrorism have expanded our list of possible targets to include "fleeting" targets, individuals or other small targets with a very limited opportunity timeframe. Thus speed to target, "a compressed kill chain," will be an increasingly critical aspect of precision strike. What does that future of precision strike look like?

**Imagine** a future battlespace with persistent global **ISR**, which has satellites, loitering **UAVs**, and micro-ground sensors feed data into a massive database to identify and target threats in real-time. In case of a major threat, a suborbital Common Aero Vehicle **(CAV)** or stand-off Unmanned Combat Aerial Vehicle **(UCAV)** will launch hypersonic missiles or kinetic-energy munitions impacting on the designated target within minutes. A lesser threat will be addressed with Small Diameter Bombs **(SDB)** or smart mini-missiles, delivered by an F/A-22, or UCAV, capable of distinguishing between a mobile missile launcher and a non-combatant family van. These actions will be controlled, coordinated and executed by Airmen often removed from the actual battlefield, but with a real-time situational awareness that we can only envision today. Think of it like laser surgery – precise, non-invasive removal or "destruction" of an adversary while minimizing collateral damage. ☐


## HYPERSONIC VEHICLES

The United States Air Force and the DARPA share a vision of transforming the U.S. military's reliance on forward bases, improving strike efficiency and revolutionizing flight as we know it today. The answer? Hypersonic vehicles.

Hypersonic vehicles of the future will:

- Be "air breathing" vehicles using scramjet engines burning traditional jet fuel rather than specialized rocket fuel
- Take off from a conventional military runway or launched from another aircraft
- Travel at speeds of Mach 8+ or over 6,000 miles per hour
- Reach targets 9,000 nautical miles away in less than two hours for either reconnaissance or strike

UAVs

We marvel at the split-second reflexes and hand-eye coordination that kids and teens exhibit while playing their favorite video game and simultaneously instant messaging with a half-dozen friends. Well, the best of these will be our future generation of combat aviators.

# UNMANNED

The Air Force has used sophisticated UAVs for over a decade. We're already seeing phenomenal results in Afghanistan and Iraq, such as taking out one of al Qaeda's top lieutenants with a Hellfire missile. We are just beginning to understand the strategic and tactical impact of UAV/UCAV operations on 21st century air power, but are already aware that the capabilities offered by this family of systems can have profound implications on future warfighting capability and force structure.

Currently, being tested and further developed is the X-45C UCAV. The operational UCAV is designed to have twice the combat radius of an F-35, a 4,500 pound payload and state-of-the-art stealth features. UAV/UCAVs can be configured for both ISR and suppression of enemy air defenses missions as well as precision strike. These aircraft are operated very similarly to piloted aircraft from transportable cockpit stations that employ rotating crews.

STEALTH

# Low Observable Technology

Some technologies just keep on giving. Stealth is one such example. American aircraft designers started employing stealth characteristics in their designs as early as the 1950s and they were implemented in very elementary ways in the early spy planes including the U-2, the A-12 and the SR-71.

Stealth is a combination of technologies employing special materials that absorb radar signals and engine heat output, geometries that diffuse radar reflections, as well as, electronic countermeasures. The objective is to significantly reduce the radar "signature" of the vehicle by reducing the overall radar feedback generated by it. A common misconception is that these planes are completely invisible. They aren't. However, to an air defense system, a stealth aircraft is as hard to find as a small insect.

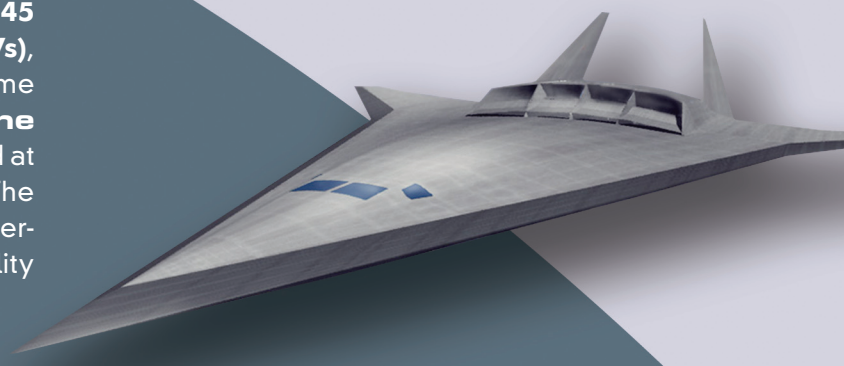
It was really another technological development, substantial computer modeling capability, that enabled giant leaps forward in stealth. In the early 1980s the F-117A was the first airplane for which every aspect was designed on the basis of stealth. A radical angular design that exhibited many unstable flight characteristics, it was again computer technology that overcame these issues. The plane was used successfully during Operation Desert Storm completing some 1,300 sorties without a single plane lost and scoring direct hits on 1,600 high-value targets. From there, computer modeling made further advances and brought us new rounded stealthy airplane designs that have been prominently


# AERIAL VEHICLES (UAVs) & COMBAT AERIAL VEHICLES (UCAVs)

What's being **imagined** for further in the future? Already being conceptualized is a vehicle with significantly greater tactical strike capabilities, displayed in the B-2 bomber, the F/A-22, the F-35, and next generation UCAVs.

Obviously detection capabilities are always improving, but stealth technologies continue to improve as well and find uses in new vehicles. Currently in various stages of development and conceptualization are the **X-45 UCAV**, new generation UAVs, Micro-Air Vehicles **(MAVs)**, as well as concept aircraft that morph shape to become more or less stealthy as the mission requires. **Imagine** virtually undetectable vehicles and weapons directed at an enemy from straight above him in near-space. The future Air Force, employing unmanned, stealthy hypersonic vehicles will provide us with increased lethality while reducing risk to our Airmen. ☐

extended cruising and loitering thresholds, and modular components to configure the vehicle based on mission requirements. On the other extreme, picture "swarms" of small, extremely stealthy UAVs employing sensors and munitions developed with nanotechnology, fully integrated into the combat network and capable of long-term loitering. **Imagine** a UAV refueling another UCAV and a next generation Global Hawk loitering at 100,000 feet! The kids and teens of future generations will have ample opportunities to contribute their skills to the defense of their country within the "unmanned" squadrons of the future Air Force. ☐



SPECIAL OPERATIONS

# Stealth is NOT CONFINED to Aircraft

By design, Air Force special operations perform under the radar and out of the public eye, but they are making ever greater contributions to the U.S. Defense Strategy and the Global War on Terrorism.

Air Force Special Operations Command (AFSOC) is a component of the U.S. Special Operations Command (USSOCOM). Currently, these **Battlefield Airmen** are the only ground combat force within the Air Force, using both fixed and rotary wing aircraft and specializing in conducting insertion, extraction, re-supply, weather advisory and controlling the assault zone.

This group of pilots, combat controllers, pararescuemen and combat weather teams serve as forward observers and scouts to guide reinforcements into an area and skillfully control or confuse the enemy through psychological and information operations.

"Do you remember the picture of a combat controller in Afghanistan on horseback with the laptop? That was us!"

Air Force Special Operations teams were critical to our delivery of precise air strikes in Afghanistan. A special operative on the ground, within close proximity of his target, using a laser designator, illuminated a spot for the laser guided bombs to hit. Once the bombs had struck he could move in and complete his mission.

Over the next ten years, we are going to see significant improvements in our special operations capability with our Battlefield Airmen becoming increasingly effective. They will receive more extensive social and cultural training for specific regions in the theater and will be able to be on the ground undetected for months at a time. AFSOC personnel will receive man-portable, tactical UAVs, and other equipment upgrades that will extend the Battlefield Airman's spheres of influence while increasing situational awareness.

They will operate under a common organizational structure and continue to receive futuristic training, increasing our already significant contribution to the joint fight. They will be equipped with the Battlefield Air Operations Kit, a suite of unique mission equipment to perform terminal attack control of air-dropped precision attack weapons. The joint battlefield will have a network-centric environment allowing special operators to receive and transmit real-time data from the ground, assisting in the deployment of air and ground assets of all services.

One of the future assets used by AFSOC is the Next Generation Gunship (NGG). The NGG will be more stealthy, with the speed and maneuverability of a jet fighter, and the long-range capability of a transporter or bomber. It will be equipped with directed energy weapons and non-lethal technologies, and could engage targets from any angle.

You can **Imagine** that in the next twenty years it will be entirely possible for a special operator to be on the ground in enemy held territory, while remotely controlling a UAV or UCAV to monitor a specific area, transmit and receive critical battlefield data on helmet mounted displays, destroy a high value target, and then receive fused joint intelligence from miniature satellite communication directing him to conduct operations in a new area.

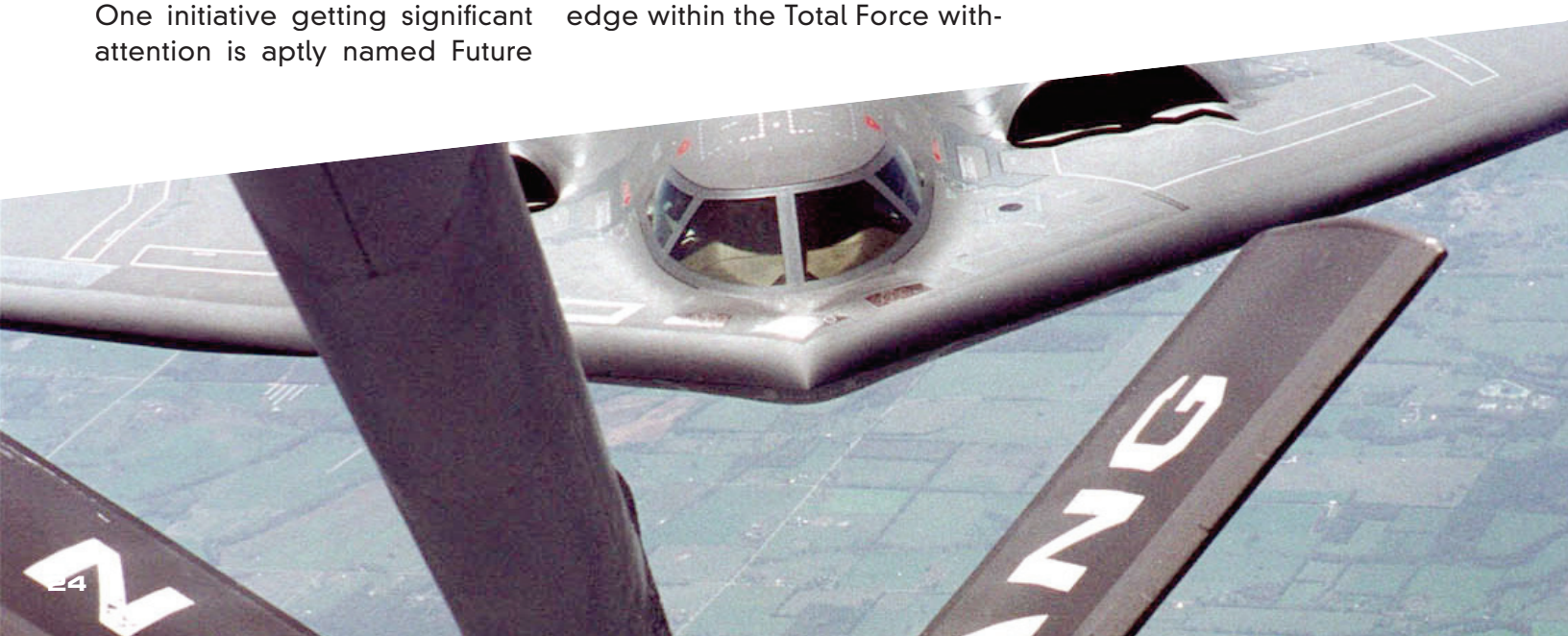
# THE TOTAL FORCE

The structural transformation into an Air and Space Expeditionary Force (AEF) has required adjustments as well as re-examination of how we train, educate, promote, organize, coordinate and assign all elements of our Total Force - active duty, Air National Guard, Air Force Reserve and civilian personnel. In fiscal year 2005, the Reserve Component accounts for more than 65% of the tactical airlift, 35% of the strategic airlift capability, 60% of the air refueling, and possesses more than 30% of the strike fighters. Senior leadership is focusing significant attention on properly calibrating the Total Force to assure that we have the right people, with the right skills, in the right place, at the right time.

One initiative getting significant attention is aptly named Future Total Force. The study group is exploring and testing a number of new organizational concepts that bring together various components of the Total Force in new ways, each designed to leverage synergies into warfighting capabilities that would be impossible for the individual units. By creatively integrating or blending various units from the Total Force, and employing new operational and administrative control concepts, these units will optimize capabilities, create efficiencies, and maximize synergies while maintaining their cultural traditions.

Continuous training and education are critical to assure that we have the right skills and knowledge within the Total Force without "stressing" certain career fields. As we have seen, the Air Force is increasingly utilizing sophisticated technology to attain desired capabilities. This also holds for training and education. New remote learning technologies and cutting edge simulators are increasingly being employed. The Air Force is committed to retrain and educate its Airmen for its new missions.

The more technologically advanced the Air Force systems become, the Air Force will need smarter and better educated airmen to operate, maintain, and support those systems. The Air Force will only be as good as the



# PREPARATION MEETING OPPORTUNITY

The Air Force is formalizing a transformational process for evaluating and applying the **Lessons Learned** from the paradigm shift of capabilities based planning. Transformational capabilities are revising Concept of Operations **(CONOPS)**, incorporating them into an integrated model for Joint Force operations. These shifts in operations offer new tools for our Warfighters to employ in future military engagements. Transformational training exercises based on these new Lessons Learned will better prepare our Airmen of the future.

The Distributed Mission Operations (DMO) concept is representative of transformational training. It is the first multi-platform, multi-location mission training center that uses advanced networking technology to maximize operational effectiveness and multiple combat capabilities. Aircrews will have the opportunity to "train like they fight." By linking simulators in multiple locations, training can be conducted between aircrews who fly different types of aircraft hundreds or thousands of miles away. It allows F-15Cs to secure air dominance, while F-16s clear the path of SAMS, so A-10s and F-15Es can strike their targets. All of this is done with aircrews that are assigned to different bases without launching a single aircraft. DMO is virtual reality for realistic training.

However, just because something works on a simulator doesn't mean that it will in a real-life threat situation. Through real-world training programs, such as the **Red Flag** weapons system training, **Blue Flag** operational deployment training, **Phoenix Readiness** expeditionary combat support course, and simulated war game exercises, Airmen test the CONOPS principles and themselves for the realities of conflict. After a CONOP is tested and validated on the training grounds, it is operationalized and continues to be refined over time.

*"The more you sweat in peace, the less you bleed in war."*

*Lieutenant General Ronald E. Keys,*
*DCS for Air and Space Operations, HQ USAF*

**Imagine** the future Airman, in a conflict theater, confident and ready, trained and prepared as a joint Warfighter, anticipating the enemy's next move. ☐

**Capabilities Review and Risk Assessment (CRRA)** is the method for reviewing how programs contribute to warfighting capabilities and effects. Centered around Task Force CONOPS, teams analyze their current status and become advocates for their required capabilities.

The current Air Force CONOPS are:

- Global Strike
- Global Persistent Attack
- Homeland Security
- Space/Command and Control, Intelligence, Surveillance and Reconnaissance
- Global Mobility
- Nuclear Response
- Agile Combat Support

# TURNING SCIENCE FICTION INTO SCIENCE FACT

Imagining the possibilities, now and into the future, comes naturally to the men and women of the Air Force Research Laboratory (AFRL). Defending America by unleashing the power of innovative air and space technology is their directive. The AFRL, through the Air Force Office of Scientific Research (AFOSR) and nine directorates, leads the discovery, development, and integration of warfighting technologies and manages all science and technology (S&T) initiatives throughout the Air Force.

Partnering with universities and industry, the AFRL makes balanced investments (far, mid, and near-term) in a wide variety of militarily relevant technologies. Six long-term challenges help focus the S&T investment beyond the 2020 horizon. These are expressed in broad terms to not limit the scope of future research, but many exciting visions are already within reach.

**Finding and Tracking:** Imagine "swarms" of micro-sensors, made possible through nanotechnology, that can enter tunnels, listen behind lines, electronically eavesdrop, or sniff out chemical and biological presence or threats.

**Command and Control:** Imagine atomic-level computing a million times faster than today's silicon chips enabling contextual interpretation of the information stream and projection of alternate future outcomes.

**Controlled Effects:** Imagine putting a warning "energy spot" on any target worldwide that could be rapidly followed with varying levels of effects, enabling a new level of deterrence available to leadership and the Joint Force Commander.

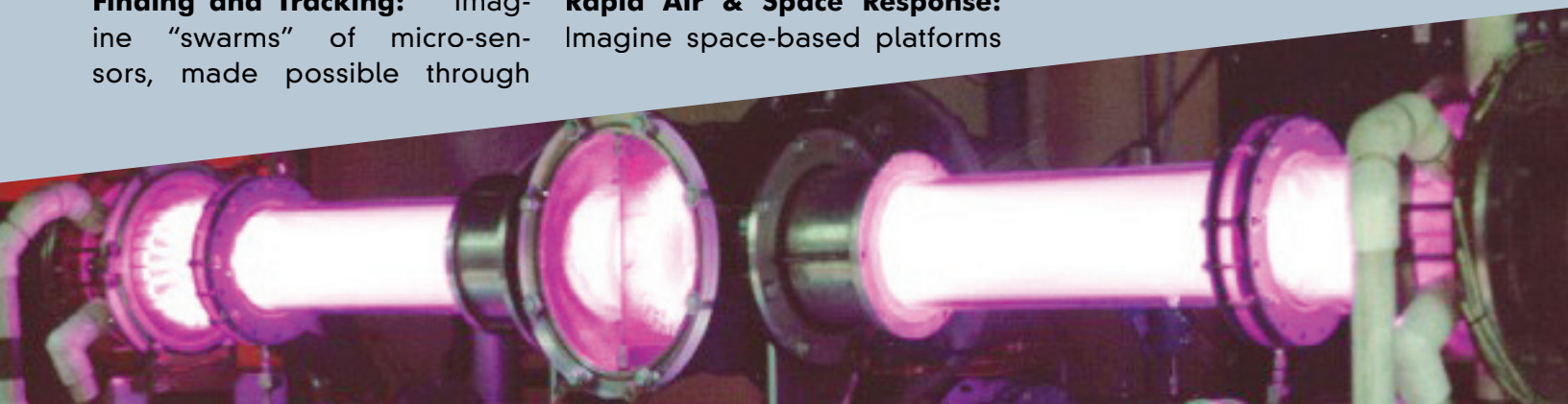
**Sanctuary:** Imagine "creating" invulnerability through means of electromagnetic spectrum manipulation including stealthy materials, camouflage skins, and dynamic jamming.

**Rapid Air & Space Response:** Imagine space-based platforms generating large quantities of energy on-orbit enabling a wider array of missions and true global presence.

**Effective Air & Space Persistence:** Imagine on-orbit maintenance, repair, and upgrade of space systems and "recovering" space vehicles on demand to protect space assets as well as upgrade technology.

## AIR FORCE RESEARCH DIRECTORATES:

- Air Vehicles
- Directed Energy
- Human Effectiveness
- Information
- Materials and Manufacturing
- Munitions
- Propulsion
- Sensors
- Space Vehicles



# TRAINING FOR THE FUTURE

Innovative transformational training and education programs will bring more high-tech training to our future Airmen.

Some recent project applications include:

- Advanced Cockpit Technology & Instrument Flight Trainer (ACTIFT), adding a glass cockpit, out-of-the-window visual scene generation, GPS, and other training capabilities.
- CV-22 simulator which includes, state-of-the-art visual system and a realistic training database to mimic the aircraft's capabilities in all weather and terrain conditions.
- Cost effective virtual reality (CEVR), an innovative application of virtual reality imaging without the headset. This Education and Training Technology Application Program (ETTAP) funded initiative supports the Mark 84 Bomb portion of the Munitions Systems Apprentice course.
- KC-135 Boom Operator Training Hi-Fidelity Stereoscopic Display Technology Demonstrator intended to provide more realistic training and accurate capturing of data.

# THE FUTURE FORCE IS ABOUT THE PEOPLE...

Technology is dramatically changing the way the Air Force maintains air superiority. When looking into the future it is obvious that the demands on today's and tomorrow's Airmen are great. The future is full of air and space possibilities.

The Air Force is in the thrust of preparing for these advances. We are currently re-evaluating the way Airmen are educated, evaluated and promoted and are working the necessary program changes to support our human capital.

The Airmen of 2030 will stand a great chance of performing in a special operative or Space Cadre role, directly or indirectly. The Airmen of 2030 will be educated in the art of war and its consequences, be socially/politically/culturally literate, be able to think from multiple perspectives, be proficient in the art of coordination and integration, and most importantly will be able to take on a strong mentor/coach role with his fellow Airmen. They will probably speak multiple languages and be able to navigate social, physical, political and cultural terrain.

The newest and most exciting program for the future Airman is the Space Cadre program. The Space Cadre program will convert current and future Airmen into space capable roles. These Airmen will operate vehicles and space-based capabilities in near space and space. The Cadre will be able to travel from one location to another, half way around the world, or through near-space to reach an enemy target within minutes of a threat. The Cadre will lead the future Space Superiority. ☐

# SPACE HUMAN CAPITAL RESOURCES STRATEGY

Ensures people have the education, skills and experiences needed to develop space power and strategy, more importantly, to bring that power to warfighting intelligence and other national security needs.

**U. S. AIR FORCE**


## Acknowledgements

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